SEQUENCE LISTING

<110> Dartois, Veronique A.
     Hoch, James A.
     Valle, Fernando
     Kumar, Manoj

<120> 2,5-DKG Permeases

<130> GC687-3-D1

<140> US 10/787,267
<141> 2004-02-25

<150> US 09/922,501
<151> 2001-08-03

<150> US 60/325,774
<151> 2000-08-04

<150> US 60/421,141
<151> 2000-09-29

<160> 22

<170> FastSEQ for Windows Version 4.0

<210> 1
<211> 1500
<212> DNA
<213> Unknown

<220>
<223> environmental source

<220>
<221> CDS
<222> (94)...(1374)

<400> 1
ggcgaatagc ccggccggcg tcataataac ggccttctct gtaccctaca tacggcggcg   60
gcgtcatgaa cctcaacttt agtaggcaag cct atg aac agc tct acc aat gca   114
                                   Met Asn Ser Ser Thr Asn Ala
                                   1   5

acg aaa cgc tgg tgg tac atc atg cct atc gtg ttt atc acg tat agc   162
Thr Lys Arg Trp Trp Tyr Ile Met Pro Ile Val Phe Ile Thr Tyr Ser
        10   15   20

ctg gcg tat ctc gac cgc gca aac ttc agc ttt gct tcg gca gcg ggc   210
Leu Ala Tyr Leu Asp Arg Ala Asn Phe Ser Phe Ala Ser Ala Ala Gly
    25   30   35

att acg gaa gat tta ggc att acc aaa ggc atc tcg tcg ctt ctt ggc   258

1

```
Ile Thr Glu Asp Leu Gly Ile Thr Lys Gly Ile Ser Ser Leu Leu Gly
 40                  45                  50                      55


gca ctt ttc ttc ctc ggc tat ttc ttc ttc cag atc ccg ggg gcg att      306
Ala Leu Phe Phe Leu Gly Tyr Phe Phe Phe Gln Ile Pro Gly Ala Ile
                    60                  65                  70


tac gcg gaa cgc cgt agc gta cgg aag ctg att ttc atc tgt ctg atc      354
Tyr Ala Glu Arg Arg Ser Val Arg Lys Leu Ile Phe Ile Cys Leu Ile
                75                  80                  85


ctg tgg ggc gcc tgc gcc tcg ctt gac cgg gat ggt gca caa tat tcc      402
Leu Trp Gly Ala Cys Ala Ser Leu Asp Arg Asp Gly Ala Gln Tyr Ser
            90                  95                  100


agc gct ggc tgg cga tcc gtt tta ttc tcg gct gtc gtg gaa gcg gcg      450
Ser Ala Gly Trp Arg Ser Val Leu Phe Ser Ala Val Val Glu Ala Ala
        105                 110                 115


gtc atg ccg gcg atg ctg att tac atc agt aac tgg ttt acc aaa tca      498
Val Met Pro Ala Met Leu Ile Tyr Ile Ser Asn Trp Phe Thr Lys Ser
120                 125                 130                 135


gaa cgt tca cgc gcc aac acc ttc tta atc ctc ggc aac ccg gtc acg      546
Glu Arg Ser Arg Ala Asn Thr Phe Leu Ile Leu Gly Asn Pro Val Thr
                140                 145                 150


gta ctg tgg atg tcg gtg gtc tcc ggc tac ctg att cag tcc ttc ggc      594
Val Leu Trp Met Ser Val Val Ser Gly Tyr Leu Ile Gln Ser Phe Gly
            155                 160                 165


tgg cgt gaa atg ttt att att gaa ggc gtt ccg gcc gtc ctc tgg gcc      642
Trp Arg Glu Met Phe Ile Ile Glu Gly Val Pro Ala Val Leu Trp Ala
            170                 175                 180


ttc tgc tgg tgg gtg ctg gtc aaa gtt aaa ccg tcg cag gtg aac tgg      690
Phe Cys Trp Trp Val Leu Val Lys Val Lys Pro Ser Gln Val Asn Trp
        185                 190                 195


ttg tcg gaa aac gag aaa gcc gcg ctg cag gcg cag ctg gag agc gag      738


Leu Ser Glu Asn Glu Lys Ala Ala Leu Gln Ala Gln Leu Glu Ser Glu
200                 205                 210                 215


cag cag ggt att aaa gcc gtg cgt aac tac ggc gaa gcc ttc cgc tca      786
Gln Gln Gly Ile Lys Ala Val Arg Asn Tyr Gly Glu Ala Phe Arg Ser
                220                 225                 230


cgc aac gtc att cta ctg tgc atg cag tat ttt gcc tgg agt atc ggc      834
Arg Asn Val Ile Leu Leu Cys Met Gln Tyr Phe Ala Trp Ser Ile Gly
            235                 240                 245


gtg tac ggt ttt gtg ctg tgg ttg ccg tca att att cgc agc ggc ggc      882
Val Tyr Gly Phe Val Leu Trp Leu Pro Ser Ile Ile Arg Ser Gly Gly
        250                 255                 260
```

```
gtc aat atg ggg atg gtg gaa gtc ggc tgg ctc tct tcg gtg cct tat        930
Val Asn Met Gly Met Val Glu Val Gly Trp Leu Ser Ser Val Pro Tyr
    265             270             275

ctg gcc gcg act att gcg atg atc gtc gtc tcc tgg gct tcc gat aaa        978
Leu Ala Ala Thr Ile Ala Met Ile Val Val Ser Trp Ala Ser Asp Lys
280             285             290             295

atg cag aac cgt aaa ctg ttc gtc tgg ccg ctg ctg ctg att ggc gga      1026
Met Gln Asn Arg Lys Leu Phe Val Trp Pro Leu Leu Leu Ile Gly Gly
            300             305             310

ctg gct ttt att ggc tca tgg gcc gtc ggc gct aac cat ttc tgg gcc      1074
Leu Ala Phe Ile Gly Ser Trp Ala Val Gly Ala Asn His Phe Trp Ala
            315             320             325

tct tat acc ctg ctg gtg att gcc aat gcg gca atg tac gcc cct tac      1122
Ser Tyr Thr Leu Leu Val Ile Ala Asn Ala Ala Met Tyr Ala Pro Tyr
            330             335             340

ggt ccg ttt ttc gcc atc att ccg gaa atg ctg ccg cgt aac gtc gcc      1170
Gly Pro Phe Phe Ala Ile Ile Pro Glu Met Leu Pro Arg Asn Val Ala
    345             350             355

ggt ggc gca atg gcg ctc atc aac agc atg ggg gcc tta ggt tca ttc      1218
Gly Gly Ala Met Ala Leu Ile Asn Ser Met Gly Ala Leu Gly Ser Phe
360             365             370             375

ttt ggt tcg tgg ttc gtg ggc tac ctg aac ggc acc acc ggc agt cca      1266
Phe Gly Ser Trp Phe Val Gly Tyr Leu Asn Gly Thr Thr Gly Ser Pro
            380             385             390

tca gcc tca tac att ttc atg gga gtg gcg ctt ttc gcc tcg gta tgg      1314
Ser Ala Ser Tyr Ile Phe Met Gly Val Ala Leu Phe Ala Ser Val Trp
            395             400             405

ctt act tta att gtt aag cct gct aac aat caa aag ctc ccc atc ggc      1362
Leu Thr Leu Ile Val Lys Pro Ala Asn Asn Gln Lys Leu Pro Ile Gly
            410             415             420

gct cgt cac gcc tgacctttac tacttacgga gatcacgcct tgggtacgtt        1414
Ala Arg His Ala
    425

gcaggacaaa ccgataggca ccgcaaaggc tggggccatc gagcagcgcg taaacagtca    1474
gctggttgct gtcgctgtgc ggcgtc                                         1500

<210> 2
<211> 427
<212> PRT
<213> Unknown

<220>
<223> environmental source

<400> 2
Met Asn Ser Ser Thr Asn Ala Thr Lys Arg Trp Trp Tyr Ile Met Pro
```

3

```
     1                    5                         10                        15
   Ile Val Phe Ile Thr Tyr Ser Leu Ala Tyr Leu Asp Arg Ala Asn Phe
                     20                        25                        30
   Ser Phe Ala Ser Ala Ala Gly Ile Thr Glu Asp Leu Gly Ile Thr Lys
                35                        40                        45
   Gly Ile Ser Ser Leu Leu Gly Ala Leu Phe Phe Leu Gly Tyr Phe Phe
                50                        55                        60
   Phe Gln Ile Pro Gly Ala Ile Tyr Ala Glu Arg Arg Ser Val Arg Lys
   65                        70                        75                        80
   Leu Ile Phe Ile Cys Leu Ile Leu Trp Gly Ala Cys Ala Ser Leu Asp
                     85                        90                        95
   Arg Asp Gly Ala Gln Tyr Ser Ser Ala Gly Trp Arg Ser Val Leu Phe
                100                       105                       110
   Ser Ala Val Val Glu Ala Ala Val Met Pro Ala Met Leu Ile Tyr Ile
                115                       120                       125
   Ser Asn Trp Phe Thr Lys Ser Glu Arg Ser Arg Ala Asn Thr Phe Leu
                130                       135                       140
   Ile Leu Gly Asn Pro Val Thr Val Leu Trp Met Ser Val Val Ser Gly
   145                       150                       155                       160
   Tyr Leu Ile Gln Ser Phe Gly Trp Arg Glu Met Phe Ile Ile Glu Gly
                     165                       170                       175
   Val Pro Ala Val Leu Trp Ala Phe Cys Trp Trp Val Leu Val Lys Val
                180                       185                       190
   Lys Pro Ser Gln Val Asn Trp Leu Ser Glu Asn Glu Lys Ala Ala Leu
                195                       200                       205
   Gln Ala Gln Leu Glu Ser Glu Gln Gln Gly Ile Lys Ala Val Arg Asn
                210                       215                       220
   Tyr Gly Glu Ala Phe Arg Ser Arg Asn Val Ile Leu Leu Cys Met Gln
   225                       230                       235                       240
   Tyr Phe Ala Trp Ser Ile Gly Val Tyr Gly Phe Val Leu Trp Leu Pro
                     245                       250                       255
   Ser Ile Ile Arg Ser Gly Gly Val Asn Met Gly Met Val Glu Val Gly
                260                       265                       270
   Trp Leu Ser Ser Val Pro Tyr Leu Ala Ala Thr Ile Ala Met Ile Val
                275                       280                       285
   Val Ser Trp Ala Ser Asp Lys Met Gln Asn Arg Lys Leu Phe Val Trp
                290                       295                       300
   Pro Leu Leu Leu Ile Gly Gly Leu Ala Phe Ile Gly Ser Trp Ala Val
   305                       310                       315                       320
   Gly Ala Asn His Phe Trp Ala Ser Tyr Thr Leu Leu Val Ile Ala Asn
                     325                       330                       335
   Ala Ala Met Tyr Ala Pro Tyr Gly Pro Phe Phe Ala Ile Ile Pro Glu
                340                       345                       350
   Met Leu Pro Arg Asn Val Ala Gly Gly Ala Met Ala Leu Ile Asn Ser
                355                       360                       365
   Met Gly Ala Leu Gly Ser Phe Phe Gly Ser Trp Phe Val Gly Tyr Leu
                370                       375                       380
   Asn Gly Thr Thr Gly Ser Pro Ser Ala Ser Tyr Ile Phe Met Gly Val
   385                       390                       395                       400
   Ala Leu Phe Ala Ser Val Trp Leu Thr Leu Ile Val Lys Pro Ala Asn
                     405                       410                       415
   Asn Gln Lys Leu Pro Ile Gly Ala Arg His Ala
                420                       425
```

<210> 3
<211> 1775
<212> DNA

4

<213> Unknown

<220>
<223> environmental source

<220>
<221> CDS
<222> (214)...(1491)

<400> 3
```
ggcaatttgc ggtgtttttt ccgcaggacg ttcatcgtcc ggcctgtatt catcaacggc        60
cctgcgctat tcgcaaagtg gtggtgaaaa taccgctgcg ttatttaacg cccaataagc       120
aacaccgagt ttataaccct gaacgacacg gctgcgggcc tgtgtagacg ccccctacgcc      180
ttaacaccac taaatgactc tacaggtgta tat atg aat aca gcc tct gtt tct        234
                                    Met Asn Thr Ala Ser Val Ser
                                     1               5

gtc acc caa agc cag gcg atc ccc aaa tta cgc tgg ttg aga ata gtg        282
Val Thr Gln Ser Gln Ala Ile Pro Lys Leu Arg Trp Leu Arg Ile Val
        10              15               20

ccg cct att ctt att acc tgc att att tcc tat atg gac cgg gtg aac        330
Pro Pro Ile Leu Ile Thr Cys Ile Ile Ser Tyr Met Asp Arg Val Asn
    25              30               35

atc gcc ttc gcc atg ccc ggc ggc atg gac gat gaa ctg ggc atc acc        378
Ile Ala Phe Ala Met Pro Gly Gly Met Asp Asp Glu Leu Gly Ile Thr
 40              45               50                       55

gcc tcg atg gcc ggg ttg gcc ggc ggt att ttc ttt atc ggt tat ctg        426
Ala Ser Met Ala Gly Leu Ala Gly Gly Ile Phe Phe Ile Gly Tyr Leu
                60               65               70

ttc ttg cag gta ccc ggc ggc aag ctg gcg gtg tac ggc aac ggc aag        474
Phe Leu Gln Val Pro Gly Gly Lys Leu Ala Val Tyr Gly Asn Gly Lys
            75               80               85

aaa ttc atc ggt tgg tcg ttg ttg gcc tgg gcg gtg att tcc gtg ctg        522
Lys Phe Ile Gly Trp Ser Leu Leu Ala Trp Ala Val Ile Ser Val Leu
        90               95               100

acc ggg ctg gtc acg aat cag tat caa ttg ctg ttc ctg cgc ttc gcc        570
Thr Gly Leu Val Thr Asn Gln Tyr Gln Leu Leu Phe Leu Arg Phe Ala
    105              110              115

ctc ggc cgt ttc cga agc ggc atg ctg cgg tgg gtg ctg acc atg atc        618
Leu Gly Arg Phe Arg Ser Gly Met Leu Arg Trp Val Leu Thr Met Ile
120              125              130              135

agc aac tgg ttc ccg gac aag gaa cgc ggg cgc gcc aac gcc atc gtc        666
Ser Asn Trp Phe Pro Asp Lys Glu Arg Gly Arg Ala Asn Ala Ile Val
                140              145              150

atc atg ttc gtg ccg atc gcc ggc atc ctt acc gca ccg ctg tcc ggc        714
Ile Met Phe Val Pro Ile Ala Gly Ile Leu Thr Ala Pro Leu Ser Gly
            155              160              165
```

5

```
tgg atc atc acc gcc tgg gac tgg cgc atg ctg ttc ctg gtc gag ggc        762
Trp Ile Ile Thr Ala Trp Asp Trp Arg Met Leu Phe Leu Val Glu Gly
        170             175             180

gcg ctg tcg ctg gtc gtg atg gtg ctg tgg tat ttc acc atc agc aac        810
Ala Leu Ser Leu Val Val Met Val Leu Trp Tyr Phe Thr Ile Ser Asn
        185             190             195

cgt cca caa gag gcc aaa agg att tcg cag gcg gaa aaa gat tat ctg        858
Arg Pro Gln Glu Ala Lys Arg Ile Ser Gln Ala Glu Lys Asp Tyr Leu
200             205             210             215

atc aaa acg ctg cac gac gaa cag ttg ctg atc aaa ggc aaa acg gtg        906
Ile Lys Thr Leu His Asp Glu Gln Leu Leu Ile Lys Gly Lys Thr Val
                220             225             230

cgc aac gcc tcg ctg cgt cgg gtg ctg ggc gac aaa atc atg tgg aag        954
Arg Asn Ala Ser Leu Arg Arg Val Leu Gly Asp Lys Ile Met Trp Lys
            235             240             245

ttc ttc tac cag acc ggg ata tac ggc tac acc ctg tgg ctg ccg acc       1002
Phe Phe Tyr Gln Thr Gly Ile Tyr Gly Tyr Thr Leu Trp Leu Pro Thr
            250             255             260

att ctc aag ggg ctc acc aac ggc aat atg gag cag gtc ggg atg ctg       1050
Ile Leu Lys Gly Leu Thr Asn Gly Asn Met Glu Gln Val Gly Met Leu
        265             270             275

gct atc ctg ccc tat atc ggc gcc atc ttc ggc atg ctg atc att tcc       1098
Ala Ile Leu Pro Tyr Ile Gly Ala Ile Phe Gly Met Leu Ile Ile Ser
280             285             290             295

acc ctc tcc gat cgc acc ggc aag cgc aaa gtg ttc gtc gca ctg ccg       1146
Thr Leu Ser Asp Arg Thr Gly Lys Arg Lys Val Phe Val Ala Leu Pro
                300             305             310

ctg gcc tgc ttt gcc atc tgc atg gcg ctg tcg gtg ctg ctg aag gat       1194
Leu Ala Cys Phe Ala Ile Cys Met Ala Leu Ser Val Leu Leu Lys Asp
            315             320             325

cac atc tgg tgg tcg tac gcg gcg ctg gtg ggc tgt ggc gtc ttt acc       1242
His Ile Trp Trp Ser Tyr Ala Ala Leu Val Gly Cys Gly Val Phe Thr
            330             335             340

cag gcc gcc gcc ggg gtg ttc tgg acc att ccg ccc aag ctg ttt aac       1290
Gln Ala Ala Ala Gly Val Phe Trp Thr Ile Pro Pro Lys Leu Phe Asn
        345             350             355

gcc gaa atg gcc ggc ggc gcg cgc ggc gtg atc aat gca ctg ggc aac       1338
Ala Glu Met Ala Gly Gly Ala Arg Gly Val Ile Asn Ala Leu Gly Asn
360             365             370             375

ctc ggc ggt ttc tgc ggc ccc tat atg gtc ggc gtg ttg atc acc ttg       1386
Leu Gly Gly Phe Cys Gly Pro Tyr Met Val Gly Val Leu Ile Thr Leu
            380             385             390
```

6

```
ttc agc aaa gac gtc ggc gtt tac agc ctc gcg gtg tcg ctg gcc tcc     1434
Phe Ser Lys Asp Val Gly Val Tyr Ser Leu Ala Val Ser Leu Ala Ser
            395               400               405

gcc tcg gtg ctg gcg ttg atg ctg ccg aac aga tgc gac caa aaa gcg     1482
Ala Ser Val Leu Ala Leu Met Leu Pro Asn Arg Cys Asp Gln Lys Ala
            410               415               420

ggg gcc gaa taatggacta ttggctgggg ctggactgcg gcggcacctt            1531
Gly Ala Glu
        425

tatcaaagcc ggcctgtatg accggaatgg cgcagaactg ggcatagccc gccgtacgct   1591
ggacattgtc gcgccgcaac ccggctgggc ggaacgtgac atgcccgcgc tgtggcagac   1651
cgccgccgag gtgatccgcg aattgctggc ccgcaacgac attgccgacg ctgatattca   1711
ggccatcggc atctcggcgc agggtaaagg cgcgtttttg ttagacgagc aaggccaacc   1771
gttg                                                                1775
```

<210> 4
<211> 426
<212> PRT
<213> Unknown

<220>
<223> environmental source

<400> 4
```
Met Asn Thr Ala Ser Val Ser Val Thr Gln Ser Gln Ala Ile Pro Lys
  1               5                  10                  15
Leu Arg Trp Leu Arg Ile Val Pro Pro Ile Leu Ile Thr Cys Ile Ile
            20                  25                  30
Ser Tyr Met Asp Arg Val Asn Ile Ala Phe Ala Met Pro Gly Gly Met
            35                  40                  45
Asp Asp Glu Leu Gly Ile Thr Ala Ser Met Ala Gly Leu Ala Gly Gly
        50                  55                  60
Ile Phe Phe Ile Gly Tyr Leu Phe Leu Gln Val Pro Gly Gly Lys Leu
65                  70                  75                  80
Ala Val Tyr Gly Asn Gly Lys Lys Phe Ile Gly Trp Ser Leu Leu Ala
                85                  90                  95
Trp Ala Val Ile Ser Val Leu Thr Gly Leu Val Thr Asn Gln Tyr Gln
            100                 105                 110
Leu Leu Phe Leu Arg Phe Ala Leu Gly Arg Phe Arg Ser Gly Met Leu
            115                 120                 125
Arg Trp Val Leu Thr Met Ile Ser Asn Trp Phe Pro Asp Lys Glu Arg
            130                 135                 140
Gly Arg Ala Asn Ala Ile Val Ile Met Phe Val Pro Ile Ala Gly Ile
145                 150                 155                 160
Leu Thr Ala Pro Leu Ser Gly Trp Ile Ile Thr Ala Trp Asp Trp Arg
                165                 170                 175
Met Leu Phe Leu Val Glu Gly Ala Leu Ser Leu Val Val Met Val Leu
            180                 185                 190
Trp Tyr Phe Thr Ile Ser Asn Arg Pro Gln Glu Ala Lys Arg Ile Ser
            195                 200                 205
Gln Ala Glu Lys Asp Tyr Leu Ile Lys Thr Leu His Asp Glu Gln Leu
        210                 215                 220
Leu Ile Lys Gly Lys Thr Val Arg Asn Ala Ser Leu Arg Arg Val Leu
```

7

```
          225                        230                        235                        240
Gly Asp Lys Ile Met Trp Lys Phe Phe Tyr Gln Thr Gly Ile Tyr Gly
                245                        250                        255
Tyr Thr Leu Trp Leu Pro Thr Ile Leu Lys Gly Leu Thr Asn Gly Asn
                260                        265                        270
Met Glu Gln Val Gly Met Leu Ala Ile Leu Pro Tyr Ile Gly Ala Ile
                275                        280                        285
Phe Gly Met Leu Ile Ile Ser Thr Leu Ser Asp Arg Thr Gly Lys Arg
        290                        295                        300
Lys Val Phe Val Ala Leu Pro Leu Ala Cys Phe Ala Ile Cys Met Ala
305                        310                        315                        320
Leu Ser Val Leu Leu Lys Asp His Ile Trp Trp Ser Tyr Ala Ala Leu
                325                        330                        335
Val Gly Cys Gly Val Phe Thr Gln Ala Ala Ala Gly Val Phe Trp Thr
                340                        345                        350
Ile Pro Pro Lys Leu Phe Asn Ala Glu Met Ala Gly Gly Ala Arg Gly
                355                        360                        365
Val Ile Asn Ala Leu Gly Asn Leu Gly Gly Phe Cys Gly Pro Tyr Met
        370                        375                        380
Val Gly Val Leu Ile Thr Leu Phe Ser Lys Asp Val Gly Val Tyr Ser
385                        390                        395                        400
Leu Ala Val Ser Leu Ala Ser Ala Ser Val Leu Ala Leu Met Leu Pro
                405                        410                        415
Asn Arg Cys Asp Gln Lys Ala Gly Ala Glu
                420                        425
```

<210> 5
<211> 1478
<212> DNA
<213> Klebsiella oxytoca

<220>
<221> CDS
<222> (73)...(1353)

<400> 5
```
ttgcccgccg ccgctgctca gaccatcgat cttttctatg atgagcgtca cctcactcac      60
agaggcaaac ct atg aat agt tca acg aat gca aca aaa cgc tgg tgg tac     111
           Met Asn Ser Ser Thr Asn Ala Thr Lys Arg Trp Trp Tyr
             1               5                      10

atc atg cct atc gtg ttt atc acg tat agc ctg gcg tac ctc gac cgc     159
Ile Met Pro Ile Val Phe Ile Thr Tyr Ser Leu Ala Tyr Leu Asp Arg
     15                  20                  25

gct aac ttc agc ttc gct tcg gcg gcc gga att act gaa gac ctg ggg     207
Ala Asn Phe Ser Phe Ala Ser Ala Ala Gly Ile Thr Glu Asp Leu Gly
 30                  35                  40                  45

atc acc aaa ggt atc tcc tcc ctt ctg ggg gcg ctg ttc ttc ctc ggc     255
Ile Thr Lys Gly Ile Ser Ser Leu Leu Gly Ala Leu Phe Phe Leu Gly
                50                  55                  60

tac ttc ttc ttt cag atc ccc ggc gcg att tat gcc gaa cgc cgc agc     303
Tyr Phe Phe Phe Gln Ile Pro Gly Ala Ile Tyr Ala Glu Arg Arg Ser
            65                  70                  75
```

8

```
gta cgt aaa ctc att ttc atc tgc ctg atc ctg tgg ggt gcc tgc gcc          351


Val Arg Lys Leu Ile Phe Ile Cys Leu Ile Leu Trp Gly Ala Cys Ala
        80                  85                  90

tca ctc gac cgg gat ggt gca caa tat tcc cgc gct ggg cgg gcg atc          399
Ser Leu Asp Arg Asp Gly Ala Gln Tyr Ser Arg Ala Gly Arg Ala Ile
        95                  100                 105

cgc ttt atc ctt ggc gtg gtc gag gcc gca gtc atg ccg gcg atg ctg          447
Arg Phe Ile Leu Gly Val Val Glu Ala Ala Val Met Pro Ala Met Leu
110                 115                 120                 125

ata tac atc agc aac tgg ttt acc aaa tcc gaa cgc tcg cgc gcc aat          495
Ile Tyr Ile Ser Asn Trp Phe Thr Lys Ser Glu Arg Ser Arg Ala Asn
                130                 135                 140

acc ttc ctg atc ctc ggc aac ccg gtg acg gtg ctg tgg atg tcg gtg          543
Thr Phe Leu Ile Leu Gly Asn Pro Val Thr Val Leu Trp Met Ser Val
            145                 150                 155

gtc tcc ggc tac ctg att cag gct ttc ggc tgg cgg gag atg ttt att          591
Val Ser Gly Tyr Leu Ile Gln Ala Phe Gly Trp Arg Glu Met Phe Ile
            160                 165                 170

att gaa ggc gtt ccg gcg gtg att tgg gcc ttc tgc tgg tgg gtg ctg          639
Ile Glu Gly Val Pro Ala Val Ile Trp Ala Phe Cys Trp Trp Val Leu
        175                 180                 185

gta aaa gat aaa ccg tct cag gtc aac tgg ctg gcg gaa agc gaa aag          687
Val Lys Asp Lys Pro Ser Gln Val Asn Trp Leu Ala Glu Ser Glu Lys
110                 195                 200                 205

gcc gca ttg cag gag cag ctg gag cgc gaa cag cag ggt atc aaa ccg          735
Ala Ala Leu Gln Glu Gln Leu Glu Arg Glu Gln Gln Gly Ile Lys Pro
                210                 215                 220

gtg cgc aac tac ggt gag gcc ttc cgc tcg cgt aac gtg gtc ctg ctg          783
Val Arg Asn Tyr Gly Glu Ala Phe Arg Ser Arg Asn Val Val Leu Leu
                225                 230                 235

tgc atg caa tat ttc gcc tgg agc atc ggg gtt tac ggt ttc gtg ctg          831
Cys Met Gln Tyr Phe Ala Trp Ser Ile Gly Val Tyr Gly Phe Val Leu
                240                 245                 250

tgg ctg ccg tca att atc cgc agc ggc ggc gag aat atg ggc atg gtc          879
Trp Leu Pro Ser Ile Ile Arg Ser Gly Gly Glu Asn Met Gly Met Val
        255                 260                 265

gag gtc ggc tgg ctc tca tcc gtc ccc tac ctg gcg gca acc atc gcc          927
Glu Val Gly Trp Leu Ser Ser Val Pro Tyr Leu Ala Ala Thr Ile Ala
270                 275                 280                 285

atg atc gtg gtc tcc tgg gcc tcc gat aaa atg cag aac cgc aag cta          975
Met Ile Val Val Ser Trp Ala Ser Asp Lys Met Gln Asn Arg Lys Leu
                290                 295                 300
```

9

```
ttc gtc tgg ccg ctg ctg ctg att gcc gcc ttc gcg ttt att ggc tcc      1023
Phe Val Trp Pro Leu Leu Leu Ile Ala Ala Phe Ala Phe Ile Gly Ser
            305                 310                 315

tgg gcc gtc ggc gct aac cat ttc tgg gtc tct tat acc ctg ctg gtc      1071
Trp Ala Val Gly Ala Asn His Phe Trp Val Ser Tyr Thr Leu Leu Val
            320                 325                 330

att gcc ggc gcg gcg atg tac gcc ccc tac ggg ccg ttc ttc gcc atc      1119
Ile Ala Gly Ala Ala Met Tyr Ala Pro Tyr Gly Pro Phe Phe Ala Ile
            335                 340                 345

att ccc gag atg ctg ccg cgt aac gtc gcc ggg ggc gcc atg gcg ctg      1167
Ile Pro Glu Met Leu Pro Arg Asn Val Ala Gly Gly Ala Met Ala Leu
350                 355                 360                 365

att aac agc atg ggc gcg ctg ggt tca ttc ttt ggc tca tgg ttt gtc      1215
Ile Asn Ser Met Gly Ala Leu Gly Ser Phe Phe Gly Ser Trp Phe Val
                370                 375                 380

ggc tac ctg aac ggc acc acc ggc agc ccg tca gcc tcg tac att ttt      1263
Gly Tyr Leu Asn Gly Thr Thr Gly Ser Pro Ser Ala Ser Tyr Ile Phe
                385                 390                 395

atg gga gtg gcg ctt ttc gtc tcg gta tgg ctt act ttg att gtt aag      1311
Met Gly Val Ala Leu Phe Val Ser Val Trp Leu Thr Leu Ile Val Lys
            400                 405                 410

cct gct aat aat caa aaa ctt ccg ctc ggc gca cgt cac gcc              1353
Pro Ala Asn Asn Gln Lys Leu Pro Leu Gly Ala Arg His Ala
    415                 420                 425

tgaaacatta acgcaacgga gaaccgcatg aagccgtcag tcattctcta caaaacgctt   1413
cccgacgacc tgcaacaagc gtctggaaca acactttacc gtcacgcagg tgaaaaacct   1473
gcgtt                                                              1478

<210> 6
<211> 427
<212> PRT
<213> Klebsiella oxytoca

<400> 6
Met Asn Ser Ser Thr Asn Ala Thr Lys Arg Trp Trp Tyr Ile Met Pro
 1               5                  10                  15
Ile Val Phe Ile Thr Tyr Ser Leu Ala Tyr Leu Asp Arg Ala Asn Phe
            20                  25                  30
Ser Phe Ala Ser Ala Ala Gly Ile Thr Glu Asp Leu Gly Ile Thr Lys
            35                  40                  45
Gly Ile Ser Ser Leu Leu Gly Ala Leu Phe Phe Leu Gly Tyr Phe Phe
        50                  55                  60
Phe Gln Ile Pro Gly Ala Ile Tyr Ala Glu Arg Arg Ser Val Arg Lys
65                  70                  75                  80
Leu Ile Phe Ile Cys Leu Ile Leu Trp Gly Ala Cys Ala Ser Leu Asp
                85                  90                  95
Arg Asp Gly Ala Gln Tyr Ser Arg Ala Gly Arg Ala Ile Arg Phe Ile
            100                 105                 110
```

10

```
Leu Gly Val Val Glu Ala Ala Val Met Pro Ala Met Leu Ile Tyr Ile
        115                 120                 125
Ser Asn Trp Phe Thr Lys Ser Glu Arg Ser Arg Ala Asn Thr Phe Leu
    130                 135                 140
Ile Leu Gly Asn Pro Val Thr Val Leu Trp Met Ser Val Val Ser Gly
145                 150                 155                 160
Tyr Leu Ile Gln Ala Phe Gly Trp Arg Glu Met Phe Ile Ile Glu Gly
                165                 170                 175
Val Pro Ala Val Ile Trp Ala Phe Cys Trp Trp Val Leu Val Lys Asp
            180                 185                 190
Lys Pro Ser Gln Val Asn Trp Leu Ala Glu Ser Glu Lys Ala Ala Leu
        195                 200                 205
Gln Glu Gln Leu Glu Arg Glu Gln Gln Gly Ile Lys Pro Val Arg Asn
    210                 215                 220
Tyr Gly Glu Ala Phe Arg Ser Arg Asn Val Val Leu Leu Cys Met Gln
225                 230                 235                 240


Tyr Phe Ala Trp Ser Ile Gly Val Tyr Gly Phe Val Leu Trp Leu Pro
                245                 250                 255
Ser Ile Ile Arg Ser Gly Gly Glu Asn Met Gly Met Val Glu Val Gly
            260                 265                 270
Trp Leu Ser Ser Val Pro Tyr Leu Ala Ala Thr Ile Ala Met Ile Val
        275                 280                 285
Val Ser Trp Ala Ser Asp Lys Met Gln Asn Arg Lys Leu Phe Val Trp
    290                 295                 300
Pro Leu Leu Leu Ile Ala Ala Phe Ala Phe Ile Gly Ser Trp Ala Val
305                 310                 315                 320
Gly Ala Asn His Phe Trp Val Ser Tyr Thr Leu Leu Val Ile Ala Gly
            325                 330                 335
Ala Ala Met Tyr Ala Pro Tyr Gly Pro Phe Phe Ala Ile Ile Pro Glu
            340                 345                 350
Met Leu Pro Arg Asn Val Ala Gly Gly Ala Met Ala Leu Ile Asn Ser
        355                 360                 365
Met Gly Ala Leu Gly Ser Phe Phe Gly Ser Trp Phe Val Gly Tyr Leu
    370                 375                 380
Asn Gly Thr Thr Gly Ser Pro Ser Ala Ser Tyr Ile Phe Met Gly Val
385                 390                 395                 400
Ala Leu Phe Val Ser Val Trp Leu Thr Leu Ile Val Lys Pro Ala Asn
                405                 410                 415
Asn Gln Lys Leu Pro Leu Gly Ala Arg His Ala
            420                 425
```

<210> 7
<211> 1600
<212> DNA
<213> Pantoea citrea

<220>
<221> CDS
<222> (214)...(1521)

<400> 7
```
tctgagcttt tcccgacctt atccctgtca gatccctgcc tggttcacga accttgtaac      60
acactttctt aacatgccct tacgtgaccc tgatcccaca ctgtcagtgc aaaaacacgt     120
tttatagctc ctgataagca cagttcgcag cgcgtaactg cacccgcagg gttctgcttt     180
gcgtcaactg acaaaacaga aaggggatat atc atg caa aaa tca cag ccg gga     234
```

```
                                    Met Gln Lys Ser Gln Pro Gly
                                     1                   5

acc cgc tgg ttt cgg att att gtg ccg atc ctg ata gcc tgc atc atg      282
Thr Arg Trp Phe Arg Ile Ile Val Pro Ile Leu Ile Ala Cys Ile Met
        10              15                  20

tcg ttt atg gat cgg gta aat atc agt ttc gca ttg ccg ggc ggt atg      330
Ser Phe Met Asp Arg Val Asn Ile Ser Phe Ala Leu Pro Gly Gly Met
        25              30                  35

gag cag gat ctg ctg atg tcc agc cag atg gcc ggg gta gtt agc ggt      378
Glu Gln Asp Leu Leu Met Ser Ser Gln Met Ala Gly Val Val Ser Gly
 40              45                  50                      55

att ttc ttt att ggt tat ctg ttt ttg cag gtt cct ggt ggg cat atc      426
Ile Phe Phe Ile Gly Tyr Leu Phe Leu Gln Val Pro Gly Gly His Ile
                    60              65                  70

gca gta cgt ggc agt ggt aaa cgt ttt att gcc tgg tcg ctt gtt gcc      474
Ala Val Arg Gly Ser Gly Lys Arg Phe Ile Ala Trp Ser Leu Val Ala
                75                  80                  85

tgg gcc gtt gtt tct gtc gct acc ggg ttt gtg act cat cag tac cag      522
Trp Ala Val Val Ser Val Ala Thr Gly Phe Val Thr His Gln Tyr Gln
        90                  95                  100

ctg ttg att tta cgt ttt gca ctg ggg gtc tct gaa ggt ggg atg ttg      570
Leu Leu Ile Leu Arg Phe Ala Leu Gly Val Ser Glu Gly Gly Met Leu
        105                 110                 115

ccg gta gtt ctg aca atg gtc agc aac tgg ttt cct gaa aaa gag ctg      618
Pro Val Val Leu Thr Met Val Ser Asn Trp Phe Pro Glu Lys Glu Leu
120                 125                 130                 135

ggg cgt gct aat gca ttt gtc atg atg ttc gcc ccg ctt ggc gga atg      666
Gly Arg Ala Asn Ala Phe Val Met Met Phe Ala Pro Leu Gly Gly Met
                140                 145                 150

att acc gcc cct gtc tcc gga tgg att att gca ctg cta gac tgg cgc      714
Ile Thr Ala Pro Val Ser Gly Trp Ile Ile Ala Leu Leu Asp Trp Arg
                155                 160                 165

tgg tta ttt att atc gaa gga tta ctg tcg gta gtg gtt ctg gca gtc      762
Trp Leu Phe Ile Ile Glu Gly Leu Leu Ser Val Val Val Leu Ala Val
        170                 175                 180

tgg tgg ctg atg gtc agt gac cgc cct gaa gat gcc cgt tgg ctg ccg      810
Trp Trp Leu Met Val Ser Asp Arg Pro Glu Asp Ala Arg Trp Leu Pro
        185                 190                 195

gca gca gaa cgg gaa tat ctg ctg cgc gaa atg gcc cgt gac aag gcc      858
Ala Ala Glu Arg Glu Tyr Leu Leu Arg Glu Met Ala Arg Asp Lys Ala
200                 205                 210                 215

gag cgg agc aaa ctc cct ccg atc agt cat gct ccc ctg caa gag gtt      906
Glu Arg Ser Lys Leu Pro Pro Ile Ser His Ala Pro Leu Gln Glu Val
```

12

```
ttc cat aac ccg ggc ctg atg aag tta gtg att ctg aac ttt ttc tat      954
Phe His Asn Pro Gly Leu Met Lys Leu Val Ile Leu Asn Phe Phe Tyr
        235                 240                 245

cag aca ggt gat tac gga tac act ctg tgg ctg ccg act att atc aaa     1002
Gln Thr Gly Asp Tyr Gly Tyr Thr Leu Trp Leu Pro Thr Ile Ile Lys
        250                 255                 260

aac ctg acc gga gct agt att ggt aac gtc ggt ttg ctg aca gtg cta     1050
Asn Leu Thr Gly Ala Ser Ile Gly Asn Val Gly Leu Leu Thr Val Leu
        265                 270                 275

cct ttt atc gcg acg tta tca ggg att tat gtc gtc tct tac ctg agc     1098
Pro Phe Ile Ala Thr Leu Ser Gly Ile Tyr Val Val Ser Tyr Leu Ser
280                 285                 290                 295

gat aaa acc ggc aaa cgt cgg caa tgg gtg atg att tct ctg ttc tgt     1146
Asp Lys Thr Gly Lys Arg Arg Gln Trp Val Met Ile Ser Leu Phe Cys
                300                 305                 310

ttt gcg gcc tgc ctg ttg gcc tca gtc ctg tta cgt gaa ttt gtg ctg     1194
Phe Ala Ala Cys Leu Leu Ala Ser Val Leu Leu Arg Glu Phe Val Leu
            315                 320                 325

gct gct tat ctg gct ctg gtg gct tgc ggc ttt ttc ctg aaa gca gcc     1242
Ala Ala Tyr Leu Ala Leu Val Ala Cys Gly Phe Phe Leu Lys Ala Ala
            330                 335                 340


acc agc ccg ttc tgg agt att ccg gga cgt att gca ccg ccg gaa gca     1290
Thr Ser Pro Phe Trp Ser Ile Pro Gly Arg Ile Ala Pro Pro Glu Ala
            345                 350                 355

gcc ggt agt gcc cgt ggt gta att aac gga ctg ggg aat ctg ggc ggt     1338
Ala Gly Ser Ala Arg Gly Val Ile Asn Gly Leu Gly Asn Leu Gly Gly
360                 365                 370                 375

ttc tgc ggc ccc tgg ctg gtc gga tta atg atc tac ctg tac gga cag     1386
Phe Cys Gly Pro Trp Leu Val Gly Leu Met Ile Tyr Leu Tyr Gly Gln
                380                 385                 390

aat gca gcc gtt gtt act ctg gca ggc tct ctg atc att gcc ggg att     1434
Asn Ala Ala Val Val Thr Leu Ala Gly Ser Leu Ile Ile Ala Gly Ile
                395                 400                 405

att gcg gca tta ctg cca acg cag tgt gat ctg cgc ccg gca gag gca     1482
Ile Ala Ala Leu Leu Pro Thr Gln Cys Asp Leu Arg Pro Ala Glu Ala
            410                 415                 420

cgg cag cag aat ttc acc cca cgt att cat gat gcc aaa taatactgtc     1531
Arg Gln Gln Asn Phe Thr Pro Arg Ile His Asp Ala Lys
        425                 430                 435

acccggtaac gctgttgccg ggtgcagcct tcacctttca gggcgtattt ttctgataac     1591
cccgtgtaa                                                             1600
```

<210> 8
<211> 436
<212> PRT
<213> Pantoea citrea

<400> 8
```
Met Gln Lys Ser Gln Pro Gly Thr Arg Trp Phe Arg Ile Ile Val Pro
 1               5                  10                  15
Ile Leu Ile Ala Cys Ile Met Ser Phe Met Asp Arg Val Asn Ile Ser
            20                  25                  30
Phe Ala Leu Pro Gly Gly Met Glu Gln Asp Leu Leu Met Ser Ser Gln
            35                  40                  45
Met Ala Gly Val Val Ser Gly Ile Phe Phe Ile Gly Tyr Leu Phe Leu
    50                  55                  60
Gln Val Pro Gly Gly His Ile Ala Val Arg Gly Ser Gly Lys Arg Phe
65                  70                  75                  80
Ile Ala Trp Ser Leu Val Ala Trp Ala Val Val Ser Val Ala Thr Gly
                85                  90                  95
Phe Val Thr His Gln Tyr Gln Leu Leu Ile Leu Arg Phe Ala Leu Gly
            100                 105                 110
Val Ser Glu Gly Gly Met Leu Pro Val Val Leu Thr Met Val Ser Asn
            115                 120                 125
Trp Phe Pro Glu Lys Glu Leu Gly Arg Ala Asn Ala Phe Val Met Met
    130                 135                 140
Phe Ala Pro Leu Gly Gly Met Ile Thr Ala Pro Val Ser Gly Trp Ile
145                 150                 155                 160
Ile Ala Leu Leu Asp Trp Arg Trp Leu Phe Ile Ile Glu Gly Leu Leu
                165                 170                 175
Ser Val Val Val Leu Ala Val Trp Trp Leu Met Val Ser Asp Arg Pro
            180                 185                 190
Glu Asp Ala Arg Trp Leu Pro Ala Ala Glu Arg Glu Tyr Leu Leu Arg
            195                 200                 205
Glu Met Ala Arg Asp Lys Ala Glu Arg Ser Lys Leu Pro Pro Ile Ser
    210                 215                 220
His Ala Pro Leu Gln Glu Val Phe His Asn Pro Gly Leu Met Lys Leu
225                 230                 235                 240
Val Ile Leu Asn Phe Phe Tyr Gln Thr Gly Asp Tyr Gly Tyr Thr Leu
                245                 250                 255
Trp Leu Pro Thr Ile Ile Lys Asn Leu Thr Gly Ala Ser Ile Gly Asn
            260                 265                 270
Val Gly Leu Leu Thr Val Leu Pro Phe Ile Ala Thr Leu Ser Gly Ile
            275                 280                 285
Tyr Val Val Ser Tyr Leu Ser Asp Lys Thr Gly Lys Arg Arg Gln Trp
    290                 295                 300
Val Met Ile Ser Leu Phe Cys Phe Ala Ala Cys Leu Leu Ala Ser Val
305                 310                 315                 320
Leu Leu Arg Glu Phe Val Leu Ala Ala Tyr Leu Ala Leu Val Ala Cys
                325                 330                 335
Gly Phe Phe Leu Lys Ala Ala Thr Ser Pro Phe Trp Ser Ile Pro Gly
            340                 345                 350
Arg Ile Ala Pro Pro Glu Ala Ala Gly Ser Ala Arg Gly Val Ile Asn
            355                 360                 365
Gly Leu Gly Asn Leu Gly Gly Phe Cys Gly Pro Trp Leu Val Gly Leu
    370                 375                 380
Met Ile Tyr Leu Tyr Gly Gln Asn Ala Ala Val Val Thr Leu Ala Gly
```

```
385                    390                      395                      400
Ser Leu Ile Ile Ala Gly Ile Ile Ala Ala Leu Leu Pro Thr Gln Cys
                405                      410                      415
Asp Leu Arg Pro Ala Glu Ala Arg Gln Gln Asn Phe Thr Pro Arg Ile
            420                      425                  430
His Asp Ala Lys
        435


<210> 9
<211> 1500
<212> DNA
<213> Pantoea citrea

<220>
<221> CDS
<222> (154)...(1440)

<400> 9
tcagctcagg cctcggattt cgttaacggt catgtcttat ttgtcgacgg cggaatgctg       60
gcctcagtat aaaatacagg ggcagacgga atcagagttt gccctgaaga tatcttactg      120
gttgcccctt cggcacacac aggatgttcc ccc atg aat aca agc aga aaa ctg      174
                                     Met Asn Thr Ser Arg Lys Leu
                                      1                   5


ccg gtg aaa cgc tgg tgg tat tta atg ccg gtg att ttt att act tac      222
Pro Val Lys Arg Trp Trp Tyr Leu Met Pro Val Ile Phe Ile Thr Tyr
        10                  15                  20


agc ctg gca tat ctg gat cgg gcc aac tac ggc ttt gct gct gcc tct      270
Ser Leu Ala Tyr Leu Asp Arg Ala Asn Tyr Gly Phe Ala Ala Ala Ser
    25                  30                  35


ggg att gaa gca gat ctt gga att agc cgt ggc acc tcc tct ctg att      318
Gly Ile Glu Ala Asp Leu Gly Ile Ser Arg Gly Thr Ser Ser Leu Ile
40                  45                  50                  55


gga gca ctg ttc ttt ctc ggc tac ttc att ttt cag gtg ccc ggg gca      366
Gly Ala Leu Phe Phe Leu Gly Tyr Phe Ile Phe Gln Val Pro Gly Ala
                60                  65                  70


att tat gca gtg aaa cgc agt gtc cgt aaa ctg gtg ttt acc agc ctg      414
Ile Tyr Ala Val Lys Arg Ser Val Arg Lys Leu Val Phe Thr Ser Leu
                75                  80                  85


ctg ttg tgg gga ttt tgt gcc gct gcg acc gga ctt atc agc aat att      462
Leu Leu Trp Gly Phe Cys Ala Ala Ala Thr Gly Leu Ile Ser Asn Ile
            90                  95                  100


ccg gct ctg atg gtg atc cgc ttt gtt ctg ggt gtt gtt gaa gcc gca      510
Pro Ala Leu Met Val Ile Arg Phe Val Leu Gly Val Val Glu Ala Ala
        105                 110                 115


gtg atg cca gcg atg ctg att tac atc agc aac tgg ttc acc cgt cag      558
Val Met Pro Ala Met Leu Ile Tyr Ile Ser Asn Trp Phe Thr Arg Gln
120                 125                 130                 135


gaa cgt tca cgg gct aat acc ttt ctg gta tta ggt aac ccg gtc acg      606
```

15

```
Glu Arg Ser Arg Ala Asn Thr Phe Leu Val Leu Gly Asn Pro Val Thr
            140                 145                 150

gtg tta tgg atg tct att gtt tcc gga tat ctg atc aat gct ttt ggc      654
Val Leu Trp Met Ser Ile Val Ser Gly Tyr Leu Ile Asn Ala Phe Gly
            155                 160                 165

tgg cgg gaa atg ttt att ttc gag ggt gtg cct gcc tta atc tgg gcc      702
Trp Arg Glu Met Phe Ile Phe Glu Gly Val Pro Ala Leu Ile Trp Ala
            170                 175                 180

atc ttc tgg tgg ttt att gtc cgg gac aaa ccg gag cag gtg agc tgg      750
Ile Phe Trp Trp Phe Ile Val Arg Asp Lys Pro Glu Gln Val Ser Trp
            185                 190                 195

ctg aca gaa aca gaa aag cag caa ctg gcc agt gca atg gct gaa gag      798
Leu Thr Glu Thr Glu Lys Gln Gln Leu Ala Ser Ala Met Ala Glu Glu
200                 205                 210                 215

cag cag gca ata cca ccg atg cgc aat gtg ccg cag gcc ctg cgt tcc      846
Gln Gln Ala Ile Pro Pro Met Arg Asn Val Pro Gln Ala Leu Arg Ser
                220                 225                 230

cgc aat gtg gtg gta ctg tgc ctg tta cac gct ctg tgg agc atc gga      894
Arg Asn Val Val Val Leu Cys Leu Leu His Ala Leu Trp Ser Ile Gly
                235                 240                 245

gtg tat ggt ttt atg atg tgg atg cca tcg ata ctg cgt agc gct gca      942
Val Tyr Gly Phe Met Met Trp Met Pro Ser Ile Leu Arg Ser Ala Ala
                250                 255                 260

tca atg gac att gtc cgg gta ggc tgg ctg gcc gca gtt ccg tat ctg      990
Ser Met Asp Ile Val Arg Val Gly Trp Leu Ala Ala Val Pro Tyr Leu
            265                 270                 275

gcc gcg att att act atg ctg gtg att tca tgg ctg tca gat aaa acc     1038
Ala Ala Ile Ile Thr Met Leu Val Ile Ser Trp Leu Ser Asp Lys Thr
280                 285                 290                 295

ggg ctg cgt cgg ctt ttt atc tgg cca tta ttg ctg att gcg tca gtt     1086
Gly Leu Arg Arg Leu Phe Ile Trp Pro Leu Leu Leu Ile Ala Ser Val
            300                 305                 310

act ttt ttt ggg tcc tgg tta ctt ggg agc tac tca ttc tgg ttt tcc     1134
Thr Phe Phe Gly Ser Trp Leu Leu Gly Ser Tyr Ser Phe Trp Phe Ser
            315                 320                 325

tat ggc ttg ctg gta ctg gct gct gct tgt atg tat gcc ccg tat gga     1182
Tyr Gly Leu Leu Val Leu Ala Ala Ala Cys Met Tyr Ala Pro Tyr Gly
            330                 335                 340

ccg ttt ttt gcg ttg att cct gaa ttg ctg cca aaa aat gtg gcg ggg     1230
Pro Phe Phe Ala Leu Ile Pro Glu Leu Leu Pro Lys Asn Val Ala Gly
            345                 350                 355

att tct atc ggg tta att aac tgt tgc ggg gcg ctg gga gct ttt gcc     1278
Ile Ser Ile Gly Leu Ile Asn Cys Cys Gly Ala Leu Gly Ala Phe Ala
```

16

```
gga gcc tgg ctg gtg ggc tat ctt aat ggt ctg acc ggt ggt ccg ggg          1326
Gly Ala Trp Leu Val Gly Tyr Leu Asn Gly Leu Thr Gly Gly Pro Gly
             380                  385                  390

gct tct tac act ttt atg gcc att gca ttg ctg gtt tct gta ggg ttg          1374
Ala Ser Tyr Thr Phe Met Ala Ile Ala Leu Leu Val Ser Val Gly Leu
             395                  400                  405

gtg ttt ttc ctg aaa gtc cct tca ggg aat ttg gtc act cgt cgg ttg          1422
Val Phe Phe Leu Lys Val Pro Ser Gly Asn Leu Val Thr Arg Arg Leu
             410                  415                  420

ctg aaa ggt gat gca aag taaaaggaat agcgatgaaa cggaacagga                 1470
Leu Lys Gly Asp Ala Lys
         425

tgtctttgca ggatattgcg gacctcgccg                                          1500
```

```
<210> 10
<211> 429
<212> PRT
<213> Pantoea citrea

<400> 10
Met Asn Thr Ser Arg Lys Leu Pro Val Lys Arg Trp Trp Tyr Leu Met
 1               5                   10                  15
Pro Val Ile Phe Ile Thr Tyr Ser Leu Ala Tyr Leu Asp Arg Ala Asn
             20                  25                  30
Tyr Gly Phe Ala Ala Ala Ser Gly Ile Glu Ala Asp Leu Gly Ile Ser
             35                  40                  45
Arg Gly Thr Ser Ser Leu Ile Gly Ala Leu Phe Phe Leu Gly Tyr Phe
         50                  55                  60
Ile Phe Gln Val Pro Gly Ala Ile Tyr Ala Val Lys Arg Ser Val Arg
65                  70                  75                  80
Lys Leu Val Phe Thr Ser Leu Leu Leu Trp Gly Phe Cys Ala Ala Ala
                 85                  90                  95
Thr Gly Leu Ile Ser Asn Ile Pro Ala Leu Met Val Ile Arg Phe Val
             100                 105                 110
Leu Gly Val Val Glu Ala Ala Val Met Pro Ala Met Leu Ile Tyr Ile
         115                 120                 125
Ser Asn Trp Phe Thr Arg Gln Glu Arg Ser Arg Ala Asn Thr Phe Leu
         130                 135                 140
Val Leu Gly Asn Pro Val Thr Val Leu Trp Met Ser Ile Val Ser Gly
145                 150                 155                 160
Tyr Leu Ile Asn Ala Phe Gly Trp Arg Glu Met Phe Ile Phe Glu Gly
             165                 170                 175
Val Pro Ala Leu Ile Trp Ala Ile Phe Trp Phe Ile Val Arg Asp
             180                 185                 190
Lys Pro Glu Gln Val Ser Trp Leu Thr Glu Thr Glu Lys Gln Gln Leu
         195                 200                 205
Ala Ser Ala Met Ala Glu Glu Gln Gln Ala Ile Pro Pro Met Arg Asn
         210                 215                 220
Val Pro Gln Ala Leu Arg Ser Arg Asn Val Val Val Leu Cys Leu Leu
225                 230                 235                 240
His Ala Leu Trp Ser Ile Gly Val Tyr Gly Phe Met Met Trp Met Pro
```

```
                   245                  250                  255
Ser Ile Leu Arg Ser Ala Ala Ser Met Asp Ile Val Arg Val Gly Trp
            260                  265                  270
Leu Ala Ala Val Pro Tyr Leu Ala Ala Ile Ile Thr Met Leu Val Ile
        275                  280                  285
Ser Trp Leu Ser Asp Lys Thr Gly Leu Arg Arg Leu Phe Ile Trp Pro
    290                  295                  300
Leu Leu Leu Ile Ala Ser Val Thr Phe Phe Gly Ser Trp Leu Leu Gly
305                  310                  315                  320
Ser Tyr Ser Phe Trp Phe Ser Tyr Gly Leu Leu Val Leu Ala Ala Ala
                325                  330                  335
Cys Met Tyr Ala Pro Tyr Gly Pro Phe Phe Ala Leu Ile Pro Glu Leu
            340                  345                  350
Leu Pro Lys Asn Val Ala Gly Ile Ser Ile Gly Leu Ile Asn Cys Cys
        355                  360                  365
Gly Ala Leu Gly Ala Phe Ala Gly Ala Trp Leu Val Gly Tyr Leu Asn
    370                  375                  380
Gly Leu Thr Gly Gly Pro Gly Ala Ser Tyr Thr Phe Met Ala Ile Ala
385                  390                  395                  400
Leu Leu Val Ser Val Gly Leu Val Phe Phe Leu Lys Val Pro Ser Gly
                405                  410                  415
Asn Leu Val Thr Arg Arg Leu Leu Lys Gly Asp Ala Lys
            420                  425

<210> 11
<211> 1500
<212> DNA
<213> Klebsiella oxytoca

<220>
<221> CDS
<222> (70)...(1386)

<400> 11
ctaaaacaag cacaataata ataatcacct tcatcaccag aatattttta atattacgag        60
actataaag atg aat ata acc tct aac tct aca acc aaa gat ata ccg cgc       111
          Met Asn Ile Thr Ser Asn Ser Thr Thr Lys Asp Ile Pro Arg
           1               5                   ·10

cag cgc tgg tta aga atc att ccg cct ata ctg atc act tgt att att       159
Gln Arg Trp Leu Arg Ile Ile Pro Pro Ile Leu Ile Thr Cys Ile Ile
 15              20                  25                  30

tct tat atg gac cgg gtc aat att gcc ttt gcg atg ccc gga ggt atg       207
Ser Tyr Met Asp Arg Val Asn Ile Ala Phe Ala Met Pro Gly Gly Met
                35                  40                  45

gat gcc gac tta ggt att tcc gcc acc atg gcg ggg ctg gcg ggc ggt       255
Asp Ala Asp Leu Gly Ile Ser Ala Thr Met Ala Gly Leu Ala Gly Gly
                50                  55                  60

att ttc ttt atc ggt tat cta ttt tta cag gtt ccc ggc ggg aaa att       303
Ile Phe Phe Ile Gly Tyr Leu Phe Leu Gln Val Pro Gly Gly Lys Ile
            65                  70                  75

gcc gtt cac ggt agc ggt aag aaa ttt atc ggc tgg tcg ctg gtc gcc       351
Ala Val His Gly Ser Gly Lys Lys Phe Ile Gly Trp Ser Leu Val Ala
```

```
tgg gcg gtc atc tcc gtg ctg acg ggg tta att acc aat cag tac cag          399
Trp Ala Val Ile Ser Val Leu Thr Gly Leu Ile Thr Asn Gln Tyr Gln
 95             100             105             110

ctg ctg gcc ctg cgc ttc tta ctg ggc gtg gcg gaa ggc ggt atg ctg          447
Leu Leu Ala Leu Arg Phe Leu Leu Gly Val Ala Glu Gly Gly Met Leu
                115             120             125

ccg gtc gtt ctc acg atg atc agt aac tgg ttc ccc gac gct gaa cgc          495
Pro Val Val Leu Thr Met Ile Ser Asn Trp Phe Pro Asp Ala Glu Arg
                130             135             140

ggt cgc gcc aac gcg att gtc att atg ttt gtg ccg att gcc ggg att          543
Gly Arg Ala Asn Ala Ile Val Ile Met Phe Val Pro Ile Ala Gly Ile
                145             150             155

atc acc gcc cca ctc tca ggc tgg att atc acg gtt ctc gac tgg cgc          591
Ile Thr Ala Pro Leu Ser Gly Trp Ile Ile Thr Val Leu Asp Trp Arg
                160             165             170

tgg ctg ttt att atc gaa ggt ttg ctc tcg ctg gtt gtt ctg gtt ctg          639
Trp Leu Phe Ile Ile Glu Gly Leu Leu Ser Leu Val Val Leu Val Leu
175             180             185             190

tgg gca tac acc atc tat gac cgt ccg cag gaa gcg cgc tgg att tcc          687
Trp Ala Tyr Thr Ile Tyr Asp Arg Pro Gln Glu Ala Arg Trp Ile Ser
                195             200             205

gaa gca gag aag cgc tat ctg gtc gag acg ctg gcc gcg gag caa aaa          735
Glu Ala Glu Lys Arg Tyr Leu Val Glu Thr Leu Ala Ala Glu Gln Lys
                210             215             220

gcc att gcc ggc acc gag gtg aaa aac gcc tct ctg agc gcc gtt ctc          783
Ala Ile Ala Gly Thr Glu Val Lys Asn Ala Ser Leu Ser Ala Val Leu
                225             230             235

tcc gac aaa acc atg tgg cag ctt atc gcc ctg aac ttc ttc tac cag          831
Ser Asp Lys Thr Met Trp Gln Leu Ile Ala Leu Asn Phe Phe Tyr Gln
                240             245             250

acc ggc att tac ggc tac acc ctg tgg cta ccc acc att ctg aaa gaa          879
Thr Gly Ile Tyr Gly Tyr Thr Leu Trp Leu Pro Thr Ile Leu Lys Glu
255             260             265             270

ttg acc cat agc agc atg ggg cag gtc ggc atg ctt gcc att ctg ccg          927
Leu Thr His Ser Ser Met Gly Gln Val Gly Met Leu Ala Ile Leu Pro
                275             280             285

tac gtc ggc gcc att gct ggg atg ttc ctg ttt tcc tcc ctt tca gac          975
Tyr Val Gly Ala Ile Ala Gly Met Phe Leu Phe Ser Ser Leu Ser Asp
                290             295             300

cga acc ggt aaa cgc aag ctg ttc gtc tgc ctg ccg ctg att ggc ttc         1023
```
19

```
Arg Thr Gly Lys Arg Lys Leu Phe Val Cys Leu Pro Leu Ile Gly Phe
    305                 310                 315

gct ctg tgc atg ttc ctg tcg gtg gcg ctg aaa aac caa att tgg ctc    1071
Ala Leu Cys Met Phe Leu Ser Val Ala Leu Lys Asn Gln Ile Trp Leu
    320                 325                 330

tcc tat gcc gcg ctg gtc ggc tgc gga ttc ttc ctg caa tcg gcg gct    1119
Ser Tyr Ala Ala Leu Val Gly Cys Gly Phe Phe Leu Gln Ser Ala Ala
335                 340                 345                 350

ggc gtg ttc tgg acc atc ccg gca cgt ctg ttc agc gcg gaa atg gcg    1167
Gly Val Phe Trp Thr Ile Pro Ala Arg Leu Phe Ser Ala Glu Met Ala
                355                 360                 365

ggc ggc gcg cgc ggg gtt atc aac gcg ctt ggc aac ctc ggc gga ttt    1215
Gly Gly Ala Arg Gly Val Ile Asn Ala Leu Gly Asn Leu Gly Gly Phe
                370                 375                 380

tgt ggc cct tat gcg gtc ggg gtg ctg atc acg ttg tac agc aaa gac    1263
Cys Gly Pro Tyr Ala Val Gly Val Leu Ile Thr Leu Tyr Ser Lys Asp
            385                 390                 395

gct ggc gtc tat tgc ctg gcg atc tcc ctg gcg ctg gcc gcg ctg atg    1311
Ala Gly Val Tyr Cys Leu Ala Ile Ser Leu Ala Leu Ala Ala Leu Met
        400                 405                 410

gcg ctg ctg ctg ccg gcg aaa tgc gat gcc ggt gct gcg ccg gta aag    1359
Ala Leu Leu Leu Pro Ala Lys Cys Asp Ala Gly Ala Ala Pro Val Lys
415                 420                 425                 430


acg ata aat cca cat aaa cgc act gcg taaactcgag cccggcggcg            1406
Thr Ile Asn Pro His Lys Arg Thr Ala
                435

ctgcgcctgc cgggcctgcg aaatatgccg ggttcacccg gtaacaatga gatgcgaaag    1466
atgagcaaga aacaggcctt ctggctgggt attg                                1500

<210> 12
<211> 439
<212> PRT
<213> Klebsiella oxytoca

<400> 12
Met Asn Ile Thr Ser Asn Ser Thr Thr Lys Asp Ile Pro Arg Gln Arg
 1               5                  10                  15
Trp Leu Arg Ile Ile Pro Pro Ile Leu Ile Thr Cys Ile Ile Ser Tyr
            20                  25                  30
Met Asp Arg Val Asn Ile Ala Phe Ala Met Pro Gly Gly Met Asp Ala
        35                  40                  45
Asp Leu Gly Ile Ser Ala Thr Met Ala Gly Leu Ala Gly Gly Ile Phe
    50                  55                  60
Phe Ile Gly Tyr Leu Phe Leu Gln Val Pro Gly Gly Lys Ile Ala Val
65                  70                  75                  80
His Gly Ser Gly Lys Lys Phe Ile Gly Trp Ser Leu Val Ala Trp Ala
```

20

```
                        85                      90                      95
Val Ile Ser Val Leu Thr Gly Leu Ile Thr Asn Gln Tyr Gln Leu Leu
               100                     105                     110
Ala Leu Arg Phe Leu Leu Gly Val Ala Glu Gly Gly Met Leu Pro Val
               115                     120                     125
Val Leu Thr Met Ile Ser Asn Trp Phe Pro Asp Ala Glu Arg Gly Arg
          130                     135                     140
Ala Asn Ala Ile Val Ile Met Phe Val Pro Ile Ala Gly Ile Ile Thr
     145                     150                     155            160
Ala Pro Leu Ser Gly Trp Ile Ile Thr Val Leu Asp Trp Arg Trp Leu
                    165                     170                     175
Phe Ile Ile Glu Gly Leu Leu Ser Leu Val Val Leu Val Leu Trp Ala
               180                     185                     190
Tyr Thr Ile Tyr Asp Arg Pro Gln Glu Ala Arg Trp Ile Ser Glu Ala
               195                     200                     205
Glu Lys Arg Tyr Leu Val Glu Thr Leu Ala Ala Glu Gln Lys Ala Ile
          210                     215                     220
Ala Gly Thr Glu Val Lys Asn Ala Ser Leu Ser Ala Val Leu Ser Asp
     225                     230                     235            240
Lys Thr Met Trp Gln Leu Ile Ala Leu Asn Phe Phe Tyr Gln Thr Gly
                    245                     250                     255
Ile Tyr Gly Tyr Thr Leu Trp Leu Pro Thr Ile Leu Lys Glu Leu Thr
               260                     265                     270
His Ser Ser Met Gly Gln Val Gly Met Leu Ala Ile Leu Pro Tyr Val
          275                     280                     285
Gly Ala Ile Ala Gly Met Phe Leu Phe Ser Ser Leu Ser Asp Arg Thr
     290                     295                     300
Gly Lys Arg Lys Leu Phe Val Cys Leu Pro Leu Ile Gly Phe Ala Leu
305                     310                     315                     320
Cys Met Phe Leu Ser Val Ala Leu Lys Asn Gln Ile Trp Leu Ser Tyr
                    325                     330                     335
Ala Ala Leu Val Gly Cys Gly Phe Phe Leu Gln Ser Ala Ala Gly Val
               340                     345                     350
Phe Trp Thr Ile Pro Ala Arg Leu Phe Ser Ala Glu Met Ala Gly Gly
          355                     360                     365
Ala Arg Gly Val Ile Asn Ala Leu Gly Asn Leu Gly Gly Phe Cys Gly
     370                     375                     380
Pro Tyr Ala Val Gly Val Leu Ile Thr Leu Tyr Ser Lys Asp Ala Gly
385                     390                     395                     400
Val Tyr Cys Leu Ala Ile Ser Leu Ala Leu Ala Ala Leu Met Ala Leu
                    405                     410                     415
Leu Leu Pro Ala Lys Cys Asp Ala Gly Ala Ala Pro Val Lys Thr Ile
               420                     425                     430
Asn Pro His Lys Arg Thr Ala
          435
```

<210> 13
<211> 3153
<212> DNA
<213> Unknown

<220>
<223> environmental source

<220>
<221> CDS
<222> (292)...(1236)

21

<221> CDS
<222> (1252)...(2280)

<221> CDS
<222> (2293)...(3045)

<400> 13
```
catgcctgca ggtcgactct agaggatctc gccgcgcctc aggtcgaggg atacactcgt      60
cagcgctttc gtgccgccga actccttcga aacggcacga aactccagaa gtttgtccgt     120
atccaccccg ctcctcccaa agctttatga ggctatagga tattgatatg gtatcgataa     180
cactcctgtc aagaggcggt tttcacgcca ggcgggaggg caaaatagga ctggacaatt     240
ccttcaagcg ggatatgtta tcgataacaa atcatcttcc ggaggagagc c atg agc     297
                                                         Met Ser
                                                           1
```

```
aag atc gat gtg ttg cag gtc ggt ccc tac cct gca tgg gac gag gag     345
Lys Ile Asp Val Leu Gln Val Gly Pro Tyr Pro Ala Trp Asp Glu Glu
          5                   10                  15
```

```
cgc ctg aac gcg acc ttc acg atg cac cgc tat ttc gag gcg gcc gac     393
Arg Leu Asn Ala Thr Phe Thr Met His Arg Tyr Phe Glu Ala Ala Asp
         20                  25                  30
```

```
aag gcg gcg ttt ctg gcc gag cac ggc ggc acg atc cgc ggc atc gcc     441
Lys Ala Ala Phe Leu Ala Glu His Gly Gly Thr Ile Arg Gly Ile Ala
 35                  40                  45                  50
```

```
acg cgc ggc gag ctt ggt gcc aac cgg gcg atg atc gag gcg ctg ccg     489
Thr Arg Gly Glu Leu Gly Ala Asn Arg Ala Met Ile Glu Ala Leu Pro
                  55                  60                  65
```

```
aag ctg gaa gtg atc tcg gtc tac ggc gtc ggc ttc gat gcg gtg gac     537
Lys Leu Glu Val Ile Ser Val Tyr Gly Val Gly Phe Asp Ala Val Asp
                  70                  75                  80
```

```
ctt tcg gcg gcc cgc gag cgc ggc atc cgc gtc acc aac acg ccc gac     585
Leu Ser Ala Ala Arg Glu Arg Gly Ile Arg Val Thr Asn Thr Pro Asp
              85                  90                  95
```

```
gtg ctc acc aag gac gtg gcc gat ctc ggc atc gcc atg atg ctg gcg     633
Val Leu Thr Lys Asp Val Ala Asp Leu Gly Ile Ala Met Met Leu Ala
             100                 105                 110
```

```
cag gcg cgc ggc gtc atc ggc gga gag gcc tgg gtg aag agc ggc gat     681
Gln Ala Arg Gly Val Ile Gly Gly Glu Ala Trp Val Lys Ser Gly Asp
115                 120                 125                 130
```

```
tgg gca agc aag ggt ctc tat ccg ctg aag cgc cgc gta cat ggc atg     729
Trp Ala Ser Lys Gly Leu Tyr Pro Leu Lys Arg Arg Val His Gly Met
                 135                 140                 145
```

```
cgc gcc ggg gtg ctc ggc ctc ggc cgc atc ggc tac gag gtg gcc aag     777
Arg Ala Gly Val Leu Gly Leu Gly Arg Ile Gly Tyr Glu Val Ala Lys
                 150                 155                 160
```

```
cgc ctt gcc ggc ttc gac atg gac atc gcc tac agc gac acc ggc ccg     825
```

22

```
        Arg Leu Ala Gly Phe Asp Met Asp Ile Ala Tyr Ser Asp Thr Gly Pro
            165                     170                 175


aag gat ttc gcc agg gac tgg acc ttc gtc gcc gat ccg gcg gag ctg          873
Lys Asp Phe Ala Arg Asp Trp Thr Phe Val Ala Asp Pro Ala Glu Leu
    180                     185                 190


gcc gcc cgc tcc gac ttc ctc ttc gtc acg ctc gcc gcc tcc gcc gag          921
Ala Ala Arg Ser Asp Phe Leu Phe Val Thr Leu Ala Ala Ser Ala Glu
195                     200                 205                 210


acg cgc cac atc gtc ggc cgc aag gtc atc gag gcg ctc ggc cct gag          969
Thr Arg His Ile Val Gly Arg Lys Val Ile Glu Ala Leu Gly Pro Glu
                215                 220                 225


ggc atg ctg atc aac atc tcg cgc gct tcc aac atc gat gaa agc gcc         1017
Gly Met Leu Ile Asn Ile Ser Arg Ala Ser Asn Ile Asp Glu Ser Ala
            230                 235                 240


ctt ctc gac gcg ctg gag acg aag gcg ctc ggc tcg gcc gcg ctc gac         1065
Leu Leu Asp Ala Leu Glu Thr Lys Ala Leu Gly Ser Ala Ala Leu Asp
            245                 250                 255


gtc ttc gag ggc gag ccg aac ctc aat ccg cgt ttc ctt gcc ctc gac         1113
Val Phe Glu Gly Glu Pro Asn Leu Asn Pro Arg Phe Leu Ala Leu Asp
        260                 265                 270


aac gtc ctc ttg cag ccg cac atg gcc tcc ggc acg atc gag acc cgc         1161
Asn Val Leu Leu Gln Pro His Met Ala Ser Gly Thr Ile Glu Thr Arg
275                     280                 285                 290


aag gcc atg ggc cag ctc gtc ttc gac aac ctg tcg gcc cat ttc gac         1209
Lys Ala Met Gly Gln Leu Val Phe Asp Asn Leu Ser Ala His Phe Asp
                295                 300                 305


ggc cgg ccg ctg ccg acc ccg gtt ctg taaggagaga ggtcc atg aag gcg       1260
Gly Arg Pro Leu Pro Thr Pro Val Leu                   Met Lys Ala
            310                 315


atc gtc atc cat cag gcc aag gac ctg cgc gtc gag gac agc gcc gtc         1308
Ile Val Ile His Gln Ala Lys Asp Leu Arg Val Glu Asp Ser Ala Val
    320                     325                 330


gag gcg ccc ggc ccc ggc gag gtg gag atc cgc ctt gcc gcc ggc ggc         1356
Glu Ala Pro Gly Pro Gly Glu Val Glu Ile Arg Leu Ala Ala Gly Gly
335                     340                 345                 350


atc tgc ggc tcg gac ctg cac tac tac aac cac ggc ggc ttc ggc acg         1404
Ile Cys Gly Ser Asp Leu His Tyr Tyr Asn His Gly Gly Phe Gly Thr
                355                 360                 365


gtg cgc ctc aag gag ccg atg atc ctc ggc cat gag gtt tcc ggc cac         1452
Val Arg Leu Lys Glu Pro Met Ile Leu Gly His Glu Val Ser Gly His
            370                 375                 380


gtc gcg gcg ctc ggc gaa ggc gtc tcc ggc ctt gcc atc ggc gac ctc         1500
```

23

```
Val Ala Ala Leu Gly Glu Gly Val Ser Gly Leu Ala Ile Gly Asp Leu
        385                 390                 395

gtc gcc gtc tcg ccc tcg cgg ccc tgc ggg gcg tgc gac tat tgc ctc      1548
Val Ala Val Ser Pro Ser Arg Pro Cys Gly Ala Cys Asp Tyr Cys Leu
        400                 405                 410

aag ggc ttg gcg aac cat tgc ttc aac atg cgc ttc tac ggc tcg gcc      1596
Lys Gly Leu Ala Asn His Cys Phe Asn Met Arg Phe Tyr Gly Ser Ala
415                 420                 425                 430

atg ccc ttc ccg cac atc cag ggc gcg ttc cgc gag cgg ctg gtc gcc      1644
Met Pro Phe Pro His Ile Gln Gly Ala Phe Arg Glu Arg Leu Val Ala
                435                 440                 445

aag gcc agc cag tgc gtg aag gct gag ggc ctt tcg gca ggt gaa gcc      1692
Lys Ala Ser Gln Cys Val Lys Ala Glu Gly Leu Ser Ala Gly Glu Ala
                450                 455                 460

gcg atg gcc gag ccg ctc tcc gtc acg ctt cac gcc acg cgc cgg gcc      1740
Ala Met Ala Glu Pro Leu Ser Val Thr Leu His Ala Thr Arg Arg Ala
        465                 470                 475

ggc gaa atg ctg ggc aag cgc gtg ctc gtc acc ggc tgc ggg ccg atc      1788
Gly Glu Met Leu Gly Lys Arg Val Leu Val Thr Gly Cys Gly Pro Ile
        480                 485                 490

ggc acc ctg tcg atc ctc gcc gcc cgg cgc gcc ggc gcg gcg gag atc      1836
Gly Thr Leu Ser Ile Leu Ala Ala Arg Arg Ala Gly Ala Ala Glu Ile
495                 500                 505                 510

gtc gcc gct gac ctt tcc gag cgt gca ctc ggc ttt gcc cgc gcc gtc      1884
Val Ala Ala Asp Leu Ser Glu Arg Ala Leu Gly Phe Ala Arg Ala Val
                515                 520                 525

ggc gcg gac cgc acg gtc aac ctg tcg gaa gac cgc gac ggc ctc gtt      1932
Gly Ala Asp Arg Thr Val Asn Leu Ser Glu Asp Arg Asp Gly Leu Val
                530                 535                 540

ccg ttc agc gag aac aag gga tat ttc gat gtc ctc tac gaa tgc tcg      1980
Pro Phe Ser Glu Asn Lys Gly Tyr Phe Asp Val Leu Tyr Glu Cys Ser
                545                 550                 555

ggc gcc cag ccg gcg ctg gtt gcc ggc atc cag gcc ttg cgc ccg cgc      2028
Gly Ala Gln Pro Ala Leu Val Ala Gly Ile Gln Ala Leu Arg Pro Arg
        560                 565                 570

ggc gtc atc gtc cag ctc ggc ctc ggc ggc gag atg agc ctt ccc atg      2076
Gly Val Ile Val Gln Leu Gly Leu Gly Gly Glu Met Ser Leu Pro Met
575                 580                 585                 590

atg gcg atc acc gcc aag gaa ctg gac ctg cgc ggc tcc ttc cgc ttc      2124
Met Ala Ile Thr Ala Lys Glu Leu Asp Leu Arg Gly Ser Phe Arg Phe
                595                 600                 605

cat gag gaa ttc gcc gtc gcc gtg aag ctg atg cag ggc ggc ctc atc      2172
His Glu Glu Phe Ala Val Ala Val Lys Leu Met Gln Gly Gly Leu Ile
```

24

```
gac gtg aag ccg ctg atc acc cat act ttg ccg ctt gcc gat gcg ctt    2220
Asp Val Lys Pro Leu Ile Thr His Thr Leu Pro Leu Ala Asp Ala Leu
        625                 630                 635

cag gcc ttc gag atc gcc tcg gac aag ggg caa tcg atg aag act cag    2268
Gln Ala Phe Glu Ile Ala Ser Asp Lys Gly Gln Ser Met Lys Thr Gln
        640                 645                 650

atc gca ttc agt taaggaagag cc atg agc atc cag ctt ttc gac ctc acg  2319
Ile Ala Phe Ser             Met Ser Ile Gln Leu Phe Asp Leu Thr
655                             660                 665

ggc aag cgc gcc ctc gtc acc ggc tcc tcg cag ggt atc ggc tat gcg    2367
Gly Lys Arg Ala Leu Val Thr Gly Ser Ser Gln Gly Ile Gly Tyr Ala
        670                 675                 680

ctc gcc aag ggc ctt gcc gcc gcc ggc gcg gac atc gtc ctc aac ggc    2415
Leu Ala Lys Gly Leu Ala Ala Ala Gly Ala Asp Ile Val Leu Asn Gly
        685                 690                 695

cgc gac gcg gcc aag ctg gcg gcc gcg gcg cag gaa ctc ggc gca aag    2463
Arg Asp Ala Ala Lys Leu Ala Ala Ala Ala Gln Glu Leu Gly Ala Lys
700                 705                 710                 715

cac acg ctc gcc ttc gac gcc acc gac cat gcc gcc gtg cgc gcg gcc    2511
His Thr Leu Ala Phe Asp Ala Thr Asp His Ala Ala Val Arg Ala Ala
                720                 725                 730

atc gac gcc ttc gag gcg gag gtc ggc ccc atc gac atc ctc gtc aac    2559
Ile Asp Ala Phe Glu Ala Glu Val Gly Pro Ile Asp Ile Leu Val Asn
                735                 740                 745

aat gcc ggc atg cag cac cgc acg ccg ctg gag gat ttc ccc gcc gat    2607
Asn Ala Gly Met Gln His Arg Thr Pro Leu Glu Asp Phe Pro Ala Asp
                750                 755                 760

gcc ttc gag cgc atc ctg aag acc aac atc tcg acg gtc ttc aat gtc    2655
Ala Phe Glu Arg Ile Leu Lys Thr Asn Ile Ser Thr Val Phe Asn Val
                765                 770                 775

ggc cag gcc gtc gcg cgc cac atg atc gcg cgc ggc gcg ggc aag atc    2703
Gly Gln Ala Val Ala Arg His Met Ile Ala Arg Gly Ala Gly Lys Ile
780                 785                 790                 795

atc aac atc gcc agc gtg cag acc gcg ctc gcc cgc ccc ggc atc gcg    2751
Ile Asn Ile Ala Ser Val Gln Thr Ala Leu Ala Arg Pro Gly Ile Ala
                800                 805                 810

ccc tat acc gcc acc aag ggc gcc gtc ggc aac ctc acc aag ggc atg    2799
Pro Tyr Thr Ala Thr Lys Gly Ala Val Gly Asn Leu Thr Lys Gly Met
                815                 820                 825

gcg acc gac tgg gcg aaa tac ggc ctg caa tgc aac gcc atc gcg ccg    2847
```

25

```
Ala Thr Asp Trp Ala Lys Tyr Gly Leu Gln Cys Asn Ala Ile Ala Pro
    830                 835                 840

ggc tat ttc gac acg ccg ctc aat gcc gcg ctg gtc gcc gat ccg gcc    2895
Gly Tyr Phe Asp Thr Pro Leu Asn Ala Ala Leu Val Ala Asp Pro Ala
    845                 850                 855

ttt tcc gcc tgg ctg gaa aag cgc acg ccg gcc ggc cgc tgg ggc aag    2943
Phe Ser Ala Trp Leu Glu Lys Arg Thr Pro Ala Gly Arg Trp Gly Lys
860             865                 870                 875

gtg gag gag ctg atc ggc gcc tgc atc ttt ctt tcc tcc gac gct tcc    2991
Val Glu Glu Leu Ile Gly Ala Cys Ile Phe Leu Ser Ser Asp Ala Ser
                880             885                 890

tcc ttc gtg aac gga cac acg ctc tat gtc gac ggc ggc atc acg gcc    3039
Ser Phe Val Asn Gly His Thr Leu Tyr Val Asp Gly Gly Ile Thr Ala
                895             900                 905

tcg ctc tgaggacaac aggcgcatcg tcctgatggg cgtcgccggc tgcggcaagt    3095
Ser Leu

ccgccgtcgg cgcggcgctc gccgcgcggc tcggtgcgat ccccgggtac cgagctcg    3153

<210> 14
<211> 315
<212> PRT
<213> Unknown

<220>
<223> environmental source

<400> 14
Met Ser Lys Ile Asp Val Leu Gln Val Gly Pro Tyr Pro Ala Trp Asp
 1               5                   10                  15
Glu Glu Arg Leu Asn Ala Thr Phe Thr Met His Arg Tyr Phe Glu Ala
            20                  25                  30
Ala Asp Lys Ala Ala Phe Leu Ala Glu His Gly Gly Thr Ile Arg Gly
            35                  40                  45
Ile Ala Thr Arg Gly Glu Leu Gly Ala Asn Arg Ala Met Ile Glu Ala
    50                  55                  60
Leu Pro Lys Leu Glu Val Ile Ser Val Tyr Gly Val Gly Phe Asp Ala
65                  70                  75                  80
Val Asp Leu Ser Ala Ala Arg Glu Arg Gly Ile Arg Val Thr Asn Thr
            85                  90                  95
Pro Asp Val Leu Thr Lys Asp Val Ala Asp Leu Gly Ile Ala Met Met
            100                 105                 110
Leu Ala Gln Ala Arg Gly Val Ile Gly Gly Glu Ala Trp Val Lys Ser
            115                 120                 125
Gly Asp Trp Ala Ser Lys Gly Leu Tyr Pro Leu Lys Arg Arg Val His
    130                 135                 140
Gly Met Arg Ala Gly Val Leu Gly Leu Gly Arg Ile Gly Tyr Glu Val
145                 150                 155                 160
Ala Lys Arg Leu Ala Gly Phe Asp Met Asp Ile Ala Tyr Ser Asp Thr
            165                 170                 175
Gly Pro Lys Asp Phe Ala Arg Asp Trp Thr Phe Val Ala Asp Pro Ala
            180                 185                 190
```

26

Glu Leu Ala Ala Arg Ser Asp Phe Leu Phe Val Thr Leu Ala Ala Ser
        195   200   205
Ala Glu Thr Arg His Ile Val Gly Arg Lys Val Ile Glu Ala Leu Gly
        210   215   220
Pro Glu Gly Met Leu Ile Asn Ile Ser Arg Ala Ser Asn Ile Asp Glu
225   230   235   240
Ser Ala Leu Leu Asp Ala Leu Glu Thr Lys Ala Leu Gly Ser Ala Ala
                245   250   255
Leu Asp Val Phe Glu Gly Glu Pro Asn Leu Asn Pro Arg Phe Leu Ala
                260   265   270
Leu Asp Asn Val Leu Leu Gln Pro His Met Ala Ser Gly Thr Ile Glu
        275   280   285
Thr Arg Lys Ala Met Gly Gln Leu Val Phe Asp Asn Leu Ser Ala His
        290   295   300
Phe Asp Gly Arg Pro Leu Pro Thr Pro Val Leu
305   310   315

<210> 15
<211> 343
<212> PRT
<213> Unknown

<220>
<223> environmental source

<400> 15
Met Lys Ala Ile Val Ile His Gln Ala Lys Asp Leu Arg Val Glu Asp
  1   5   10   15
Ser Ala Val Glu Ala Pro Gly Pro Gly Glu Val Glu Ile Arg Leu Ala
                20   25   30
Ala Gly Gly Ile Cys Gly Ser Asp Leu His Tyr Tyr Asn His Gly Gly
                35   40   45
Phe Gly Thr Val Arg Leu Lys Glu Pro Met Ile Leu Gly His Glu Val

        50   55   60
Ser Gly His Val Ala Ala Leu Gly Glu Gly Val Ser Gly Leu Ala Ile
65   70   75   80
Gly Asp Leu Val Ala Val Ser Pro Ser Arg Pro Cys Gly Ala Cys Asp
                85   90   95
Tyr Cys Leu Lys Gly Leu Ala Asn His Cys Phe Asn Met Arg Phe Tyr
                100   105   110
Gly Ser Ala Met Pro Phe Pro His Ile Gln Gly Ala Phe Arg Glu Arg
                115   120   125
Leu Val Ala Lys Ala Ser Gln Cys Val Lys Ala Glu Gly Leu Ser Ala
        130   135   140
Gly Glu Ala Ala Met Ala Glu Pro Leu Ser Val Thr Leu His Ala Thr
145   150   155   160
Arg Arg Ala Gly Glu Met Leu Gly Lys Arg Val Leu Val Thr Gly Cys
                165   170   175
Gly Pro Ile Gly Thr Leu Ser Ile Leu Ala Ala Arg Arg Ala Gly Ala
                180   185   190
Ala Glu Ile Val Ala Ala Asp Leu Ser Glu Arg Ala Leu Gly Phe Ala
        195   200   205
Arg Ala Val Gly Ala Asp Arg Thr Val Asn Leu Ser Glu Asp Arg Asp
        210   215   220
Gly Leu Val Pro Phe Ser Glu Asn Lys Gly Tyr Phe Asp Val Leu Tyr

```
225                     230                     235                     240
Glu Cys Ser Gly Ala Gln Pro Ala Leu Val Ala Gly Ile Gln Ala Leu
                245                     250                     255
Arg Pro Arg Gly Val Ile Val Gln Leu Gly Leu Gly Gly Glu Met Ser
            260                     265                     270
Leu Pro Met Met Ala Ile Thr Ala Lys Glu Leu Asp Leu Arg Gly Ser
        275                     280                     285
Phe Arg Phe His Glu Glu Phe Ala Val Ala Val Lys Leu Met Gln Gly
    290                     295                     300
Gly Leu Ile Asp Val Lys Pro Leu Ile Thr His Thr Leu Pro Leu Ala
305                     310                     315                     320
Asp Ala Leu Gln Ala Phe Glu Ile Ala Ser Asp Lys Gly Gln Ser Met
                325                     330                     335
Lys Thr Gln Ile Ala Phe Ser
                340

<210> 16
<211> 251
<212> PRT
<213> Unknown

<220>
<223> environmental source

<400> 16
Met Ser Ile Gln Leu Phe Asp Leu Thr Gly Lys Arg Ala Leu Val Thr
 1               5                   10                  15
Gly Ser Ser Gln Gly Ile Gly Tyr Ala Leu Ala Lys Gly Leu Ala Ala
            20                      25                  30
Ala Gly Ala Asp Ile Val Leu Asn Gly Arg Asp Ala Ala Lys Leu Ala
        35                      40                      45
Ala Ala Ala Gln Glu Leu Gly Ala Lys His Thr Leu Ala Phe Asp Ala
    50                      55                      60
Thr Asp His Ala Ala Val Arg Ala Ala Ile Asp Ala Phe Glu Ala Glu
65                      70                      75                      80
Val Gly Pro Ile Asp Ile Leu Val Asn Asn Ala Gly Met Gln His Arg
                85                      90                      95
Thr Pro Leu Glu Asp Phe Pro Ala Asp Ala Phe Glu Arg Ile Leu Lys
            100                     105                     110
Thr Asn Ile Ser Thr Val Phe Asn Val Gly Gln Ala Val Ala Arg His
        115                     120                     125
Met Ile Ala Arg Gly Ala Gly Lys Ile Ile Asn Ile Ala Ser Val Gln
    130                     135                     140
Thr Ala Leu Ala Arg Pro Gly Ile Ala Pro Tyr Thr Ala Thr Lys Gly
145                     150                     155                     160
Ala Val Gly Asn Leu Thr Lys Gly Met Ala Thr Asp Trp Ala Lys Tyr
                165                     170                     175
Gly Leu Gln Cys Asn Ala Ile Ala Pro Gly Tyr Phe Asp Thr Pro Leu
            180                     185                     190
Asn Ala Ala Leu Val Ala Asp Pro Ala Phe Ser Ala Trp Leu Glu Lys
        195                     200                     205
Arg Thr Pro Ala Gly Arg Trp Gly Lys Val Glu Glu Leu Ile Gly Ala
    210                     215                     220
Cys Ile Phe Leu Ser Ser Asp Ala Ser Ser Phe Val Asn Gly His Thr
225                     230                     235                     240
Leu Tyr Val Asp Gly Gly Ile Thr Ala Ser Leu
                245                     250
```

28

```
<210> 17
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 17
acccaagctt caccaaaaga gtgaagagga ag                                    32

<210> 18
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 18
cgtatctaga aaaatattct ggtgatgaag gtga                                  34

<210> 19
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 19
agactctaga tccacataaa cgcactgcgt aaac                                  34

<210> 20
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 20
gaggggatcc tggcttcgtg aacgatatac tgg                                   33

<210> 21
<211> 31
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 21
aataggatcc ttcatcacca gaatattttt a                                     31

<210> 22
```

<211> 28
<212> DNA
<213> Artificial Sequence

<220>
<223> synthetic construct

<400> 22
cataggtacc ggctttcaga taggtgcc   28